

Claims

1. An optical device, comprising:
  - (a) an active semiconductor region, for providing gain to signal light passing through said active region;
  - (b) a signal-light reflector, for reflecting the signal light through the active region in a direction out of the plane of the active region; and
  - (c) a pump-light reflector, the pump-light reflector being arranged to reflect pump light so as to form a standing wave in the device; and
  - (d) an absorber that absorbs light at a wavelength of the signal light;characterised in that the absorber is arranged at a position in the device at which there is no or substantially no pump light.
2. An optical device as claimed in claim 1, in which the active region, signal-light reflector, pump-light reflector and absorber are comprised in a monolithic unit.
3. An optical device as claimed in claim 1 or claim 2, in which the absorber is arranged at or near a node in the pump standing wave.
4. An optical device as claimed in claim 3, in which the active region comprises the element for interacting with light in the device.
5. An optical device as claimed in claim 4, in which the signal light forms a signal standing-wave by reflection from the signal-light reflector.

- 29 -

6. An optical device as claimed in claim 5, in which the absorber is arranged at or near an anti-node in the signal standing-wave.
7. An optical device as claimed in any preceding claim,  
5 comprising a second device for interacting with light, comprising a gain element that absorbs the pump light to provide gain to the signal light.
8. An optical device as claimed in claim 7, in which  
10 the pump-light-absorbing element is arranged at or near an anti-node in the signal standing wave.
9. An optical device as claimed in any preceding claim, in which the signal-light reflector comprises a metal or semiconductor mirror or a dielectric stack.
10. An optical device as claimed in any preceding claim,  
15 in which the pump-light reflector comprises a metal or semiconductor mirror or a dielectric stack.
11. An optical device as claimed in any preceding claim, comprising a second pump-light reflector for reflecting the pump light back towards the pump-light reflector.
- 20 12. An optical device as claimed in claim 11, in which the second pump-light reflector comprises a metal mirror or a dielectric stack.
13. An optical device as claimed in any preceding claim, being a monolithic or composite laser structure  
25 fabricated with a bottom Bragg reflector that reflects the pump and signal, such that that the pump field forms a standing wave.
14. An optical device as claimed in any preceding claim, in which the pump-light reflector and the signal-light  
30 reflector are comprised in a single reflector.
15. An optical device as claimed in any preceding claim, comprising a second signal-light reflector for reflecting the signal light back towards the signal-light reflector.

- 30 -

16. An optical device as claimed in claim 15, in which the second signal-light reflector comprises a metal mirror stack.

17. An optical device as claimed in claim 15 or 16, in which reflections from at least the signal-light reflector and the second signal-light reflector result in a cavity or sub-cavity resonance at a signal wavelength at which the active region provides gain, further comprising a source of pump light at a pump wavelength, wherein the signal-light reflector also reflects pump light at the pump wavelength.

18. An optical device as claimed in claim 17, in which reflections from at least the signal-light reflector and the second signal-light reflector result in a cavity or sub-cavity resonance at the pump wavelength.

19. An optical device as claimed in any preceding claim, the device being arranged to provide pulses of signal light.

20. An optical device, comprising:

- (a) an active semiconductor region, for providing gain to signal light passing through said active region;
- (b) a signal-light reflector, for reflecting the signal light through the active region in a direction out of the plane of the active region; and
- (c) an absorber;

characterised in that the absorber is arranged in a position in the device that is selected to control absorption of pump light by the absorber.

21. A method of engineering an optical device, the device comprising:

- (a) an active semiconductor region, for providing gain to signal light passing through said active region;

- 31 -

- (b) a signal-light reflector, for reflecting the signal light through the active region in a direction out of the plane of the active region; and
- (c) an absorber;

5 characterised in that the method comprises the step of controlling absorption of pump light by the absorber by selecting a position for the absorber in the device.

22. An optical device, comprising:

- 10 (a) an active semiconductor region, for providing gain to signal light passing through said active region;
- (b) a signal-light reflector, for reflecting the signal light through the active region in a direction out of the plane of the active region; and
- 15 (c) a pump-light reflector;

characterised in that the pump light reflector is arranged between the signal light reflector and the active region.

23. A device as claimed in claim 20, further comprising  
20 an element for interacting with signal light in the device, the element being arranged between the pump light reflector and the signal light reflector.

24. A device as claimed in claim 21, in which the element is a saturable absorber.

25 25. An optical device comprising:

- (a) an active semiconductor region , for providing gain to signal light passing through said active region;
- 30 (b) a signal-light reflector, for reflecting the signal light through the active region in a direction out of the plane of the active region;
- (c) a pump-light reflector, the pump-light reflector being arranged to reflect pump light

- 32 -

so as to form a standing wave in the device;  
and

(d) a element, arranged in the pump standing wave,  
that absorbs pump light to provide gain to the  
5 signal light,

characterised in that the element is arranged at or near  
to an antinode of the pump standing wave.

26. An optical device as claimed in claim 26, in which  
the element is arranged such that pump light is absorbed  
10 in the same region of the active region as a region from  
which signal light is emitted.

27. An optical device as claimed in claim 26, in which  
the element is a barrier region adjacent to a quantum  
well.